

MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during December, 1884, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic ocean during the month are also given, and their approximate paths shown on chart i.

The month was unusually cold over the northwestern part of the United States, the departures below the normal temperature amounting to from 10° to 23° from Dakota westward to the Pacific. Along the Atlantic and Gulf coasts the mean temperatures were slightly above the normal.

The weather was very severe during the last half of the month from Minnesota westward to the Pacific coast, attended in Oregon and Washington Territory by unusually heavy snowfalls, causing much loss of life and property.

The precipitation was excessive in nearly all portions of the country, the exceptions being the north Pacific coast region and the Rio Grande valley. In the west Gulf states and California it was unusually heavy and resulted in destructive freshets.

On chart i. the tracks of eight barometric depressions are traced; the average number for December during the last ten years is thirteen, or five more than for December, 1884.

In the preparation of this REVIEW the following data, received up to January 20th, 1885, have been used, viz.: the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and twenty-nine Signal Service stations and seventeen Canadian stations, as telegraphed to this office; one hundred and fifty-six monthly journals and one hundred and sixty monthly means from the former, and seventeen monthly means from the latter; two hundred and sixty-six monthly registers from voluntary observers; forty-two monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports, through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs, furnished by the publishers of "The New York Maritime Register;" monthly reports from the New England Meteorological Society, and from the local weather services of Alabama, Illinois, Indiana, Iowa, Louisiana, Minnesota, Missouri, Nebraska, Ohio, and Tennessee, and of the Central Pacific Railway Company; trustworthy newspaper extracts; and special reports.

ATMOSPHERIC PRESSURE.

[Expressed in inches and hundredths.]

The distribution of mean atmospheric pressure over the United States and Canada, as determined from the tri-daily telegraphic observations of the Signal Service, is shown by the isobarometric lines on chart ii.

An area of barometric maxima is shown over the upper Missouri valley and the northern and eastern portions of Montana, the highest barometric mean, 30.32, being reported from Fort Buford, Dakota, and Poplar River, Montana. A small area, including portions of Dakota and eastern Montana, is inclosed by the isobar for 30.3, while that for 30.25 is traced from near Minnedosa, British America, southeastward to southeastern Dakota, and thence northwestward to the northern boundary of Montana to the west of Fort Benton. The mean pressure is least over southwestern Arizona and southern California and along the coasts of southern Oregon and northern California. The lowest barometric means, 29.91 and 29.93, are reported from Cape Mendocino, California, and Yuma, Arizona, respectively.

As compared with the mean pressure for the preceding month (November) a line connecting the stations where no change has occurred extends from the northwestern boundary of Montana southeastward to the east Gulf coast. To the eastward of the line mentioned an increase has taken place, while to the westward there has been a marked decrease. The increase is greatest in the extreme northwest, the Saint Lawrence valley, and northern New England, where it varies from .10 to .18. Over the central Rocky mountain districts the decrease has been unusually large. The area of barometric maxima which was shown in this region on the chart for November has apparently moved to the northward, and its position is now occupied by an area of comparatively low barometric readings. The following stations report the most marked departures as compared with November: Salt Lake City, Utah, .31; Denver, Colorado, .21; Boise City, Idaho, .20; Cheyenne, Wyoming, .18. Over nearly the entire country to the west of the line of no change, as compared with the November means, the deficiencies exceed .10.

The departures from the normal pressure for December are given in the table of miscellaneous meteorological data, and are also exhibited on chart iv. by lines connecting stations of equal departure. The normal line extends from northwestern Montana southeastward to the central Ohio valley, and thence southward to Jacksonville, Florida. To the northward of this line the mean pressure is above the normal, except over a small area in the upper lake region, where it is normal. The departures exceed .05 in central-northern Montana, in eastern Dakota, Minnesota, New England, and portions of the middle and south Atlantic states, but with the exception of .10 at New London, Connecticut, they vary from .05 to .08. To the southward of the normal line above mentioned the mean pressure is below the normal, the departures being decided over the middle plateau and middle Pacific coast regions, where they vary from .15 to .22.

BAROMETRIC RANGES.

The monthly barometric ranges were greatest in the districts from the upper Mississippi valley eastward to the New England coast, and least along the southern borders of the country; they exceeded 1.00 in the northern plateau, north Pacific coast region, and east of the one hundredth meridian, north of latitude 37° . The largest monthly ranges are: 1.50 at Eastport, Maine; 1.46 at Portland, Maine; 1.39 at Rochester and Oswego, New York; 1.39 at Grand Haven, Michigan. The smallest are: .29 and .43 at Key West and Sanford, Florida, respectively. The monthly ranges for the several stations of the Signal Service are given in the table of miscellaneous meteorological data.

AREAS OF HIGH BAROMETER.

Five well-marked areas of high barometer passed over the districts east of the Rocky mountains during the month, all of which were first observed north of Montana, or approached from the north Pacific coast. The general direction of the movement of these areas was to the southeast from the point where first observed to the upper Mississippi valley, and to the east, after the area of greatest pressure had passed to the east of that valley. The following is a detailed description of these areas as traced from the tri-daily telegraphic reports:

I.—The large area of high barometer which extended over the plateau districts at the close of the preceding month continued almost stationary until the 5th of December, when the pressure increased on the Pacific coast, and this area apparently advanced from the Pacific ocean, moving in a northeasterly direction. On the afternoon of the 5th it was central west of northern California, and by the morning of the 6th it was central near the mouth of the Columbia river, where it remained on the following morning, although its eastern quadrants had extended over the northern Rocky mountain districts. During the succeeding twenty-four hours the movement was to the southeast, covering the eastern slope of the Rocky mountains with an enclosed area of 30.50, extending from Texas to Montana, while the isobar of 30.40 enclosed the regions from the south Atlantic states to Oregon. The pressure reached its maximum in Nebraska at this report, although it remained nearly stationary both as to pressure and movement until the morning of the 9th. At midnight of the 9th the centre of this area had reached the central Ohio valley with, however, a decrease of .10 in the barometer, and during the 10th it passed over the south Atlantic states attended generally by clear weather in all districts on the Atlantic coast.

II.—This area also approached from the north Pacific coast, it being central in the upper Columbia river valley at the a. m. report of the 9th. It passed eastward to Dakota and thence northward during the 11th, extending to the southward at midnight and west of the well-marked low area in the Ohio valley, while the crest of this cold wave remained north of Dakota, where the temperature had fallen to -12° . On the morning of the 12th this area covered the northwest and the regions between the Rocky mountains extending westward to Idaho, while the centre was in the northeastern part of Dakota. It moved rapidly southward during the 12th over the Missouri valley attended by light snows, but with no decided fall in temperature, and at the a. m. report of the 13th it was central near Saint Louis, the barometer having fallen at the centre during its southern movement. The course of this area changed from south to east, and it passed over the Ohio valley to the Atlantic coast, first with decreasing pressure followed by an increase of .10 inch when central on the coast. After reaching the Atlantic coast the course changed to the northeast apparently following the coast line until beyond the limits of observation.

III.—This area remained far to the north of Montana from the 14th until the 17th, but caused decided changes in temperature in the extreme northwest and at northern mountain stations on the 14th and 15th. On the 16th the temperature ranged from -15° to -28° at the stations in Dakota and Montana. A secondary high area formed and moved southward to the lower Missouri valley, causing the temperature to fall to zero in Kansas during the 16th. This secondary area united with the original one on the 17th, and the crest of the cold wave continued in the region north of Minnesota on the morning of the 18th, where the temperature ranged from -25° to -40° . This area moved southeastward until it reached the upper Mississippi valley, after which it passed directly eastward over the lake region, causing the barometer to rise above 30.60 and to 30.70 when passing over New York and New England, thus showing, as in the preceding area described, a slight increase of pressure as it approached the coast. The course of this area also changed from east to northeast after passing off the coast, and it disappeared rapidly to the east of Sidney during the 21st.

IV.—This area appeared in the region north of Montana on the 19th, and continued central north of the United States until the 25th, although the cold attending it was felt in Nebraska on the 21st, the temperature falling to -16° at North Platte on the morning of that date, while the temperature ranged from -20° to -39° at stations to the northward. The a. m. report of the 22d indicated intense cold north of Minnesota and Dakota, the temperature being generally below -40° . This cold wave reached the west Gulf states on the 24th, attended by freezing weather in Texas and Louisiana and by a light "norther." The temperature remained very low in the extreme northwest during the 25th, but the barometer fell while the centre of this area moved eastward over the lake region, following the track of the preceding area, passing over the upper Saint Lawrence valley, northern New England, and Nova Scotia, where it was last observed on the 28th.

V.—The a. m. report of the 28th indicated the approach of a cold wave from the Northwest Territory, and the succeeding reports of the 28th, 29th, and 30th, showed an increase of pressure and a continued flow of cold air over the eastern Rocky mountain slopes, while the barometer was highest and above 30.80 at the most northerly stations at the close of the month. The advance of this area was apparently retarded by the development of a severe storm in the upper Mississippi valley, but the gradient was increased in the west quadrants of this low area, by the cold wave which moved to the southward with increased energy, causing a violent "norther" on the west Gulf coast on the 31st. At the close of the month this area extended over the Mississippi and Ohio valleys and the upper lake region, while the crest of the cold wave continued north of Dakota, where the temperature ranged from -30° to -42° , and the barometer was above 30.90.

AREAS OF LOW BAROMETER.

Eight areas of low barometer have been traced within the limits of the stations, while a number of depressions passed eastward over British America, far to the northward, but in some instances these depressions were attended by marked changes in the weather conditions of the northern districts. The centres of these disturbances could not be accurately located upon the tri-daily telegraphic charts, although their general easterly movement was well marked by changes occurring far to the south of the centre of disturbance. The areas traced within the limits of the United States all moved northeasterly from the Mississippi valley; two approached from the north Pacific coast, passing southeasterly to the west Gulf states, and one proceeded eastward to Colorado, where it disappeared, but was followed quickly by the development of a storm in the central Mississippi valley. The two depressions traced from the north Pacific coast were separated by an interval of but twenty-four hours, and they united in Arkansas, the principal area passing to the northeast.

In the following table will be found the latitude and longitude in which each area was first and last observed, and the average hourly velocity:

Areas of low barometer.	First observed.		Last observed.		Average velocity in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
No. I.....	0	0	0	0	26
II.....	37	97	49	55	46
III.....	31	95	38	74	34
IV.....	35	123	38	105	58
V.....	37	90	51	64	48
VI.....	46	127	50	62	79
VII.....	47	125	36	93	48
VIII.....	37	85	47	58	53
	43	90	51	67	
Mean hourly velocity.....					48.1

I.—This storm developed in the southwest on the 4th and was a secondary depression caused by the advance of an extended low area north of the United States. At midnight of the 3d the barometer had fallen to 29.50 and below north of Minnesota, and high areas relatively extended over the south

Atlantic states and the mountain districts, with an intervening barometric trough extending southwesterly to the Rio Grande valley from the upper lake region. This condition resulted in the formation of a second depression, central in northern Arkansas on the morning of the 4th. The rapid increase of the high area in the mountain districts forced this storm to the southeast during the succeeding twenty-four hours, and by the morning of the 5th it was central near Little Rock, the area of rain extending over the Gulf states and northward to the lake region. During the 5th the central area extended and moved slowly northward to the lower Missouri valley, while the rain extended over the lower lake region and the south Atlantic states. After reaching the lower Missouri valley this storm contracted, becoming nearly circular and increasing in energy. The barometer fell from 29.62 to 29.34 in its transit from Arkansas to Michigan, where it was central at the p. m. report of the 6th. While passing over the lake region the circular form of the central area changed to that of an ellipse, with the larger axis nearly parallel with the latitude, but inclining in the direction of the movement of the storm. This storm increased in violence as it passed over the lake region, the barometer falling to 29.06 north of Lake Ontario at 7 a. m. of the 7th, while it read more than one inch higher at stations to the east and west on this latitude. The gales attending this storm were severe in the lake region, and on the Atlantic coast as far south as Smithville, North Carolina, the strongest winds coming from the south or southwest on the Atlantic coast, while the storm was over the lake region, and from the west or northwest in the lake regions after the storm-centre had passed to the Saint Lawrence valley during the night of the 7th and the morning of the 8th. It was last observed in the extreme northeast as a decided and well-marked ocean storm, the isobar of 29.10 indicating a still lower pressure to the eastward of the coast near Sidney, at the p. m. report of the 8th.

The following notes relative to this storm have been reported by the Signal Service observers:

Smithville, North Carolina, 6th: high southerly winds prevailed from 6.30 a. m. to 5 p. m.; a velocity of 29 miles, south, was recorded at 10.06 a. m. Thirteen vessels remained in harbor during the signal display for this storm.

Cape May, New Jersey, 6th: a southeasterly gale began at 1.08 p. m.; later the wind shifted to the southwest and reached a velocity of 52 miles at 9 p. m.

Fort Myer, Virginia, 6th: strong southerly winds prevailed from 5 to 8.45 p. m., the wind reaching a velocity of thirty-one miles, south.

Knoxville, Tennessee: light rain fell during the night of the 5-6th, and ended at 10 a. m.; showers also fell from 11.04 to 11.50 a. m., and from 1.48 to 2.10 p. m., the latter being accompanied by high wind which blew down fences, signs, etc.; the wind reached a velocity of thirty-six miles from the southeast; the storm ended at 5 p. m.

Louisville, Kentucky: the barometer fell rapidly during the early morning of the 6th, and easterly winds prevailed; in the afternoon the wind shifted to southwest and blew with the force of a gale from 2 to 4.30 p. m.; the barometer rose rapidly during the evening.

Pittsburg, Pennsylvania, 6th: light northeast to east winds prevailed during the day; at 6.30 p. m. the wind shifted to northwest and blew with increased force; for five minutes it blew at the rate of thirty-three miles per hour, doing considerable damage in this city.

Columbus, Ohio, 6th: a high southwesterly wind began at 5.51 and continued until 8.16 p. m. when the wind abated but became high from the same quarter at 2.46 a. m. on the 7th; at noon on the latter date the wind veered to west and continued with gale force until 9.56 p. m.; a maximum velocity of forty-three miles from the west occurred at 1.56 p. m.

Sandusky, Ohio: the storm began during the morning of the 6th and continued until about midnight of the 7-8th, the wind being from southwest to west; a maximum

velocity of thirty-nine miles from west occurred at 8.08 p. m., on the 7th.

Toledo, Ohio, 6th: high southwesterly winds prevailed after 5 p. m., and continued until 3 a. m. on the 8th. Much damage was done by the storm in the city.

Detroit, Michigan: a high southwesterly wind began at midnight of the 6-7th, continuing all day, and during the 8th also; the maximum velocity during this storm, thirty-nine miles from southwest, occurred at 6.21 a. m. on the 8th. Boats experienced much difficulty in making trips across the river.

Port Huron, Michigan, 7th: a southwesterly gale prevailed from 1.42 a. m. until about midnight of the 7-8th; the highest velocity of the wind, thirty-seven miles southwest, occurred at 2.12 p. m. of the 7th.

Grand Haven, Michigan, 7th: during the early morning high southerly winds prevailed, which afterward shifted to west and blew with increased force throughout the day; a velocity of forty-eight miles from the west was recorded at 4.46 p. m. The storm ended about 11 a. m. on the 8th.

Erie, Pennsylvania, 6th: the storm began at 12.28 p. m. and continued until 10 a. m. on the 9th; the prevailing wind during the storm was from the west; the maximum velocity, from that quarter, occurred at 6 p. m. on the 7th.

Buffalo, New York, 6th: the storm began at 9.43 p. m.; it continued during the 7th and until 8.53 p. m. on the 8th; a maximum wind velocity of fifty-six miles per hour was recorded at both 2.03 and 6.13 p. m. on the 7th, the total movement of the wind for that day being nine hundred and ninety-seven miles. A part of the instrument shelter was blown away during this storm.

Rochester, New York, 6th: during the day brisk to high southeasterly winds prevailed, increasing to a gale at 4 p. m.; at 8.30 p. m. a velocity of thirty-six miles was recorded; at 9.45 p. m. the wind had fallen below twenty-five miles, but it attained a high velocity during the early morning of the 7th and continued high with varying force during the day. A squall blew away the cups of the anemometer at 11.18 a. m., at which time the instrument indicated sixty miles per hour; the squall lasted about twenty minutes. The clouds were of a dark and heavy appearance at an unusually low altitude, and moved with great rapidity from west-southwest. The storm, which abated at night, caused considerable damage in this vicinity.

Oswego, New York: high winds began about mid-day on the 7th, and continued until mid-day on the 9th; the maximum velocity of the wind at this station, on the 7th, was thirty-four miles from the west at 10.32 p. m. An anemometer on the beacon was blown away at 9 p. m. on the same date, after having recorded fifty-two miles. Very rough weather prevailed on the lake; the schooner "W. J. Saffell" and the propeller "Celtic" sustained damage; from fifty to one hundred feet of a new pier was carried away on the 8th; on this date a velocity of thirty seven miles from the west was recorded at 2.07 a. m.

Narragansett Pier, Rhode Island, 7th: a southeasterly gale began at 12.30 and ended at 4.30 a. m.; the wind blew at an estimated velocity of sixty-five miles per hour; steamers from New York City to Providence and Fall River were delayed by this storm.

Point Judith, Rhode Island: high southeasterly wind prevailed during the evening of the 6th; at 2.45 a. m., on the 7th, the wind suddenly increased in force to a strong gale, the velocity being estimated at fifty-five miles per hour; the storm abated at about 3 a. m. Several small buildings and considerable fencing were blown down at this place.

II.—This storm is marked as central in eastern Texas on the morning of the 11th, but it probably developed south of the west Gulf states and its energy was increased by the southerly movement of a high area immediately to the north. The rains were unusually heavy in the lower Mississippi valley during the 11th, and snow occurred to the north over the lake region and the northwest, while the principal disturbance moved directly northeast to the upper Ohio valley, attended by in-

creasing pressure, the barometer being about .20 inch higher at the centre at the 7 a. m. report of the 12th than it was on the morning of the 11th. This storm passed directly east over the southern portion of the middle Atlantic states and was last observed as central near Delaware Breakwater. It apparently lost energy as it advanced to the eastward, but while near the middle Atlantic coast, strong northeasterly winds ranging from thirty to thirty-seven miles per hour occurred on the New Jersey coast.

III.—This low area passed eastward from the Pacific during the 11th, but its centre can only be approximately located. It moved slowly eastward over the central plateau region, following the high areas then east of the Rocky mountains, but disappeared after reaching Colorado on the 14th. The a. m. report of the 14th indicated the development of a storm in the lower Mississippi valley, but this cannot be traced from the mountain districts as a continuation of number iii.

IV.—This storm was clearly defined, central near Cairo, sixteen hours after number iii. was last observed in Colorado. General rains prevailed in the Southern states and central valleys and light snows in the lake region and the northwest during the 14th. These conditions extended over all of the Atlantic coast districts during the night, the storm-centre passing over the lower lake region attended by severe gales. The pressure decreased at the centre of disturbance from 29.70 to 29.30 in passing from Cairo to Kingston, where the centre was at the 7 a. m. report of the 15th. This depression moved to the northeast, following the general course of the Saint Lawrence valley, causing dangerous gales at the northeast Canadian stations. Its centre has not been located after midnight of the 15th, but later reports indicated a change of direction towards the east. When the principal disturbance was to the northeast of Quebec, a slight secondary depression developed north of the lower lake region, causing light snows to continue in the lake region on the 16th.

The following notes are from the reports of Signal Service observers:

Louisville, Kentucky, 14th: the barometer fell rapidly until 9 p. m., when the wind shifted from southeast to southwest and blew at the rate of thirty-one miles per hour; the wind subsided at midnight.

Grand Haven, Michigan, 15th: the storm began at 4 a. m. and continued until about midnight; a velocity of thirty miles from the west occurred at 10 a. m.

Sandusky, Ohio, 15th: the storm began at 2.38 a. m. and continued until 7.38 p. m.; the maximum velocity of the wind, thirty-three miles from the west, occurred at 3 a. m.

Buffalo, New York, 15th: at 5.28 a. m. the wind veered suddenly from south-southeast to southwest and increased to a gale; it continued with great violence, the wind reaching a velocity of sixty-four miles at 8.13 a. m., and for five minutes it blew at the rate of seventy-four miles per hour. Several buildings in this city were badly damaged. Along the water front the damage was especially heavy; the lake, creek, and canal rose to such heights as to flood all cellars in this part of the city; the New York Central railroad track was submerged for a considerable distance, and in one place two hundred feet of trestle-work were carried away; a strip of land at the foot of Michigan street, locally known as the island, was submerged and fifteen small houses were washed away. The streets of the city were strewn throughout with signs, chimneys, and other debris. The waves on the lake during this storm are reported to have been the highest ever observed here.

Eric, Pennsylvania, 14th: the storm began at 8 p. m. and continued until midnight of the 15–16th; high southwest to west winds prevailed, the maximum velocity, thirty-seven miles southwest, occurring at 12.35 p. m. on the 15th.

Rochester, New York, 15th: during the early morning the wind increased to a gale, blowing from the west; the storm continued until 6.45 p. m.; the maximum velocity, fifty-four miles per hour, occurred at 9.30 a. m.

New London, Connecticut, 15th: a southeasterly gale began at 5.45 a. m. and ended at 8.05 a. m.; the maximum velocity, thirty-seven miles, occurred at 6.10 a. m.; this storm was accompanied by a dangerous cross sea in the Race; many vessels remained in harbor.

Eastport, Maine, 15th: a gale began at 10.05 a. m. and ended at 3.05 p. m., the wind reaching a velocity of forty-eight miles from the southeast at 1.35 p. m. The schooner "Hildegard" went ashore on Cutler island, twenty miles south of this station, and proved a total loss. Three steamers and eighteen schooners remained in port during the display of signals for this storm.

V.—The barometer continued low on the north Pacific coast from the 13th until the 19th, when reports from the central mountain stations indicated a southeasterly movement of this low area. A cold wave covered the districts east of the Mississippi river at midnight of the 19th, the crest of this wave being near Lake Ontario, while the low area was passing over the northern plateau region, the pressure being 29.70, or 1.00 inch lower than that observed near the crest of the cold wave. Between these conditions the gradient was uniform and the distance between the high and low was 1,800 miles. The low area moved rapidly to the southeast, and by midnight of the 20th it had reached northern Texas, while the easterly movement of the high area, above referred to, left a barometric trough extending over the Mississippi valley, thus favoring the development of low areas in the central valleys. Number v. was central in the lower Ohio valley on the 21st at 7 a. m., but the 3 p. m. report of this date showed a westerly movement to a point near Little Rock, and the midnight chart of the 21st exhibited two low areas, one in Arkansas, and the other central in the upper lake region near Milwaukee. The rapid advance of a cold wave over the eastern slope of the Rocky mountains apparently crowded these low areas to the eastward, causing the more northerly one to increase in energy and the one in the Gulf states to fill up during the 22d. This storm was violent while passing over the lake regions, the wind reaching a maximum velocity of fifty-two miles per hour at Buffalo on the 22d, when the gradient in the western quadrants was one inch to seven hundred miles. The barometer continued to fall as the storm moved to the northeastward, reaching its lowest reading, 28.99, at the extreme northeast stations, which was 0.60 inch lower than that observed at the centre of this storm in the upper lake region.

Signal Service observers report the following in regard to this storm:

Buffalo, New York, 22d: a severe southwesterly gale began at 9.23 a. m. reaching a velocity of fifty-nine miles at 4.23 p. m.; the storm continued until 6 a. m. of the 23d, a velocity of forty-four miles, west, occurring at 4 a. m.

Oswego, New York, 22d: a gale began at 4.32 p. m. and continued until 8.57 p. m., on the 23d; a wind-velocity of forty-four miles from the west occurred at 4.07 on the latter date.

New Haven, Connecticut; the schooner "Onrust" sprung a leak and sank in the harbor during a high wind and unusually heavy sea on the afternoon of the 21st.

New London, Connecticut, 21st: high southerly winds prevailed during the afternoon, beginning at 4.45 p. m. and ending at 1.20 a. m. of the 22d; a maximum velocity of thirty-six miles, south, occurred at 12.35 a. m.

Boston, Massachusetts, 21st: heavy snow fell during the early morning, with wind from the southeast; a strong gale set in at 10.24 p. m., the wind reaching a velocity of forty-four miles from the south.

Thatcher's Island, Massachusetts: on the 23d the wind veered from south to northwest and blew with the force of a gale from 3.11 a. m. to 2.51 p. m. a velocity of forty-three miles per hour occurring at 3.01 a. m.

VI.—The depression previously traced as number v. passed over the same general track to the southeast from the north Pacific coast, only preceding number vi. by twenty-four hours. When number v. reached the lower Ohio valley, number vi.

was central near Cheyenne, and the succeeding tri-daily report showed a union of these areas in the west Gulf states. After uniting there was an apparent tendency to separate, but the small area which existed in the east Gulf states sixteen hours afterwards, disappeared in front of the cold wave then advancing over the central valleys.

VII.—This area was first marked as central in east Tennessee at midnight of the 23d, but a low area had passed south-eastward from the north Pacific coast during the previous day. It moved directly north to southern Michigan during the first eight hours, while a cold wave passed rapidly south over the regions between the Mississippi river and the Rocky mountains. On the 24th the course changed to easterly and it passed over central New England, attended by general snows and followed by a decided fall of temperature over the greater portion of the districts east and south of the Missouri valley. The temperature fell to 15° and 25° at Palestine and Indianola, Texas, respectively, on the morning of the 25th. After passing east of the New England coast, this storm followed the coast line to the northeast, causing severe gales at the extreme northeast stations on the 26th. When last observed the barometer was falling at the centre and the storm was apparently increasing in force.

VIII.—This area developed in the upper Mississippi valley on the morning of the 30th, there being at the same report a low area in southern Texas. As in the two preceding storms, the development was hastened by a rapid flow of cold air from the northwest, there being at this time a well-marked cold wave far to the northwest of the storm centre. The p. m. report of the 30th, exhibited a succession of low areas extending from Lake Huron to southern Texas, with high areas extending along the Atlantic coast, and in the northwest, over mountain districts. The cold air from the north filled up the trough of low pressure during the following eight hours, and the midnight report of the 30th, exhibited a circular low area central in northern Illinois. The isothermal lines were almost south and north in the western portion of the storm area, the temperature being 57° at Chicago, and —4 at Yankton. This storm passed rapidly over the lake region to the Saint Lawrence valley, followed by a decided cold wave, high northerly winds, and general rain or snow in all districts east of the Rocky mountains.

NORTH ATLANTIC STORMS DURING DECEMBER, 1884.

[Pressure expressed in inches and in millimetres; wind-force by scale of 0-10.]

The paths of the depressions that have appeared over the north Atlantic ocean during the month are determined, approximately, from the international simultaneous observations furnished by captains and agents of ocean steamships and sailing vessels; abstracts of logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports obtained through the co-operation of the "New York Herald Weather Service," and from other miscellaneous data received at this office up to January 21st, 1885.

The international simultaneous observations are taken each day at 7 a. m. Washington, or 12 hrs. 8 m. p. m. Greenwich mean time.

For the month of December, 1884, seven depressions have been traced over the Atlantic within the region covered by the reports. Of this number, two only, low areas 3 and 6, are continuations of depressions which passed over the United States and Canada. Numbers 2 and 5, developed in the region south of 40° N., and west of 60° W., the former causing moderate gales on the North Carolina coast during its passage, while the latter displayed considerable energy near the Banks of Newfoundland. The remaining depressions appeared over the region north of the fiftieth parallel and east of the fortieth meridian.

During the first and second decades of December, 1884, moderate to strong sw. to w. and nw. gales, with rain, snow, hail, and sleet prevailed over the Atlantic between the parallels

of 40° and 55° north; from the 23d to the close of the month, the weather cleared and the winds moderated to strong breezes, reaching occasionally the force of a moderate gale. Several depressions appear to have passed eastward over the region north of the sixtieth parallel; south of 40° N., generally fine weather prevailed. Towards the close of the month, frequent and dense fogs were reported to the westward of 45° W.

The following descriptions refer to the depressions charted:

1.—At the close of November a depression occupied the ocean north of the fiftieth parallel and west of the fortieth meridian, causing moderate sw. gales over the Banks. It moved slowly eastward during December 1st and 2d, the barometer falling to 29.2 (741.7) on the fiftieth parallel during those dates. On the 1st the s. s. "Habsburg," F. Pfeiffer, commanding, had a heavy ssw. to w. gale in N. 48° 42', W. 40° 06', and the s. s. "Saint Laurent," M. de Jousselin, commanding, came under the influence of the disturbance on the 2d. The last-mentioned reported as follows: "During the afternoon of the 1st, light breeze from sw.; from 6 to 8 p. m., overcast and rainy, barometer 29.88 (758.9); after 8 p. m. the barometer began to fall rapidly and the winds increased from se. (latitude 48° 12' N., longitude 39° 0' W.). At midnight of the 1-2d, barometer 29.52 (749.8), strong sw. wind, violent squalls and high sea; 6 a. m. of the 2d, barometer 29.17 (740.9), wind w., force 7-8; 10 a. m., 29.45 (748.0), wind nw., force 7-8; 2 p. m., barometer 29.56 (750.8), wind nw., force 6; after this the weather moderated and the barometer rose slowly." The s. s. "Venetian," W. H. Trant, commanding, near N. 50° 40', W. 28° 30', on the 2d, reported as follows: "4 a. m. of 2d, light baffling winds from ssw. to sse. and wsw., incessant rain; 8 a. m., same weather, long wnw. swell; 10 a. m., set in a hard gale from ssw., barometer 29.1 (739.1), constant rain; noon, hard gale, force 8, barometer 29.02 (737.1), rainy; 2 p. m., sudden shift of wind from sw. to nw., sea not heavy, sky breaking; and wnw. swell disappearing, barometer 29.03 (737.3); 4 p. m., hard wind, rough sw. and wnw. sea, barometer rising. We have not had the wind to correspond with the low barometer." During the 2d the disturbance apparently moved in a north-easterly direction, and by the 3d it was shown as a severe storm off the Irish coast, the barometer near the centre being below 28.9 (734.0).

2.—This depression probably developed during the 2d over the region south of 35° N. and west of Bermuda; its presence was indicated by the heavy ssw. to wsw. gales, which were encountered by the s. s. "Sirius" in N. 30°, W. 66°, on that date, while ne. gales of forty miles an hour and decreasing pressure were reported from Cape Hatteras and other stations on the North Carolina coast.

On the 3d the southerly gales continued over the region between N. 30° and 37°, and W. 62° and 70°, shifting during the day to westerly.

The ship "Ariel," F. Schwings, commanding, reported a heavy gale at 10 a. m. of the 2d in N. 37° 38', W. 72° 26', lasting eight hours; the wind set in from sw. and veered to nw., accompanied by heavy rain; the minimum pressure, 29.36 (745.7), was recorded at 11 a. m. The disturbance moved northeastward, skirting the coast of Nova Scotia during the 3d, and by the morning of the 4th it was central on the Banks of Newfoundland, where it exhibited considerable energy.

The s. s. "Adriatic," H. Parsell, commanding, reported having had a sw. gale of force 8, veering to nw. during the afternoon of the 3d, in N. 41° 32', W. 65° 51'; lowest barometer, 29.32 (744.7), observed at 4 p. m.

The s. s. "Habsburg," F. Pfeiffer, commanding, near N. 43° 51', W. 56° 49', had a heavy gale during the 4th; it began with a fresh breeze from se. and falling barometer, increasing to a s. gale of force 9; the barometer fell to 28.95 (735.3), with the wind blowing with hurricane force from sw., and accompanied by heavy rain; the barometer then began to rise slowly and the wind shifted to wsw., but continued to blow with unabated force from that quarter, when it again shifted to nw. and moderated.

The depression moved rapidly northeastward and by the 5th it had reached N. 55°, W. 30°; on that date the s. s. "Norseman" in N. 50°, W. 31° had a heavy gale from sw. veering to w. by n. lasting several hours; the s. s. "Lepanto," J. T. Rogers, commanding, in N. 47° 12', W. 27° 0', had a strong gale from sw. by s. to wsw. with very high sea from wnw. and nw.

The s. s. "Thingvalla," S. T. H. Laub, commanding, reported as follows: "December 4th, during the evening, in about N. 56° 28' W. 25° 30', the barometer began to fall, with steady rain. At 8 p. m. (ship's time) the barometer (aneroid) read 29.5 (749.3), wind se. by e. force 6; at 4 a. m. of the 5th, 28.55 (725.2), wind se. force 9; 6 a. m. 28.45 (722.6), wind ssw. force 9; noon, 28.5 (723.9), wind ssw. force 10, showers of rain, ship's position by reckoning, N. 55° 55', W. 28° 16'; hove to until 6 a. m. of the 6th, drifting towards the se. at the rate of two knots an hour. At 4 p. m., barometer read 28.55 (725.2), wind sw. force 10; 6 p. m. 28.6 (726.4), same wind, no abatement; midnight, barometer 28.66 (728.0), wind wsw. force 10; 4 a. m. of the 6th, 28.8 (731.5), wind wsw. force 10. Between noon of the 5th and 8 p. m., the wind blew with hurricane force causing the whole ship to tremble, the barometer oscillating one-tenth of an inch during this time; after 8 p. m. the squalls were less frequent and fierce, and after midnight the stars became visible; before this the atmosphere was misty, partly from rain and partly from the spray blowing about."

On the 6th, the disturbance was near the British coast, causing heavy w. gales on the fiftieth parallel, and strong sw. winds in the English Channel.

3.—This was a continuation of the depression traced over the United States and Canada as low area i. It passed over the Gulf of Saint Lawrence and Newfoundland during the 8th; on the 9th, the centre of disturbance was near N. 51°, W. 45°, where the pressure was 29.0 (736.6), moderate w. wind, while moderate to strong sw. and s. gales prevailed over the region to the eastward of the above-mentioned meridian. On the 10th and 11th, the centre of disturbance was between N. 50° and 55° and W. 40° and 35°, and during those dates the pressure ranged from 29.1 (739.1) to 29.5 (749.3) over the ocean from the Banks of Newfoundland eastward to the thirtieth meridian, and strong ssw. to w gales prevailed over that area.

During those dates the steamers "Anchovia," "Ems," "Main," "Lepanto," "City of Montreal," "Arizona," "City of Richmond," and "Canada," all between N. 51° and 43° and W. 57° and 28°, experienced the gales produced by this depression. Captain Campbell, of the s. s. "Lake Nepigon," reported a very heavy gale on December 11th in N. 53°, W. 32°, frequently reaching hurricane force. Between 11 a. m. of that date and 2 a. m. of the 12th the force did not fall below 9, and it continued to blow as a severe gale until 3 p. m. of the 12th. The greatest force, 10 (12 Beaufort scale), was experienced about 9 p. m. on the 11th, from sw. The barometer had fallen steadily from the preceding midnight until 2 p. m. of the 11th, when it was lowest, 29.1 (739.1), and did not begin to rise until 6 p. m., when it went up rapidly and the wind increased in severity. The sea was very high; the after wheel-house was smashed in by a wave as the vessel dipped her stern, and one of the boats on the side was driven through the deck, the iron davits snapping in two from the weight of water shipped. The wind veered from s. to w.

During the 12th and 13th the depression was between W. 20° and 30°, the barometer remaining below 29.0 (736.6), and the s. to w. gales continuing without abatement. During the 13th the depression appears to have moved northeastward to the British coasts.

4.—On the morning of the 16th the depression charted as low area number iv. over the United States was central over the northern part of the Gulf of Saint Lawrence with the barometer below 29.2 (741.7), attended by strong w. gales to the southward of Newfoundland, and equally strong s. gales eastward to the fiftieth meridian, and was apparently moving to the northward. On the 17th the circulation of the winds near

N. 50°, W. 35° indicated the development or approach of a disturbance north of the fifty-third parallel. The s. s. "Circassian," W. Richardson, commanding, in N. 53° 20', W. 32° 30' on the 17th reported: "1 a. m., continual rain; 4 a. m., wind increasing and barometer falling rapidly; 7 a. m. barometer 29.28 (743.7), wind wsw.; noon, 29.26 (743.2), wind veering to w. and n.; 4 p. m., whole gale, barometer rising." Similar weather continued during the 18th as the disturbance moved slowly eastward, and by the 19th it was probably central over the British Isles, the steamers "City of Richmond," "Fernwood," "Clieveden," and "Bristol," having experienced heavy w. and nw. gales off the Irish coast.

5.—This disturbance apparently developed prior to, or during the 18th, in the region between N. 35° and 40° and west of W. 65°. On the 18th there was a slight fall of the barometer at stations on the Carolina coast, and nw. gales of forty miles an hour were reported, during which several vessels were driven ashore. The disturbance first became well-defined on the 19th when it was central near N. 40° W. 60°. The following reports indicate the severity of the gales produced by this depression:

S. S. "Roman," D. Williams, commanding, in N. 44° 15', W. 54° 30', on the 19th, had fresh s. breeze during the afternoon, barometer 29.2 (741.7), falling rapidly; at 6 p. m. it was blowing a severe gale from sw. (about 80 miles an hour), with torrents of rain, barometer 28.8 (731.5); 7 p. m., wind nnw., heavy cross sea; ship hove to from 10 p. m. of the 19th until 6 a. m. of the 20th.

S. S. "Pawnee," Harnden, commanding, in N. 41° 50', W. 57° 0', on the 19th had heavy s. gale with high sea, barometer 28.8 (756.9); wind afterward veered to nw. with blinding snow-squalls.

S. S. "Alexandria," W. Ramsey, commanding, had a moderate gale with heavy rain from 7 p. m. to 11 p. m., in N. 42° 16', W. 54° 34', on the 19th.

The following is an abstract of the log of the s. s. "Somer-set," Captain James, during the 18th, 19th, and 20th:

Date.	Latitude at noon.	Longitude at noon.	Wind.	Force, 6-10.	Barometer (aneroid).		Ther., Fahr.	Remarks.
					Inches.	Mill.		
Dec. 18, 8 a. m.	N. 45 48	W. 51 14	sw.	5	29.90	759.4	45	Gloomy weather and moderate sea throughout the day.
noon			w.	6	29.78	756.4	47	
8 p. m.			w.	6	29.84	757.9	43	
Dec. 19, 4 a. m.	N. 45 2	W. 55 48	wnw.	6	29.94	760.5		7 a. m., wind accompanied by heavy rain, continuing until 7 p. m., when wind shifted suddenly to nne. and commenced to blow with terrific force, raising a tremendous sea. Barometer at time of change, 28.90 (734.0).
6 a. m.			n.	6	29.90	759.4		
8 a. m.			ne.	6	29.76	755.9	40	
10 a. m.			e.	6	29.24	742.7		
noon			sse.	8	29.24	742.7	40	
4 p. m.			w.	8	28.94	735.1		
8 p. m.			nne.	10	29.10	739.1	30	
Dec. 20, 8 a. m.	N. 43 30	W. 58 6	n.	9	29.70	754.4	18	Hard gale throughout the day, decreasing rapidly towards midnight.
noon			n.	8	29.93	760.2	20	
8 p. m.			nnw.	7	30.25	768.3	22	

The s. s. "Camden," S. R. Chandler, commanding, encountered the gale in N. 43°, W. 52°, when the barometer fell to 28.4 (721.3), at 7 p. m. of the 19th. The gale began at ese., shifting to sse. and s. then falling calm for about 40 minutes, when the wind came out from sw.; afterwards had nw. and nnw. winds with low temperature.

The British brig "Lauretta," of Charlottetown, P. E. I., whose crew was rescued by the "Camden," had experienced, when 150 miles to the northward, wind of hurricane force, from e. by n., veering to nw.

The s. s. "Aurania," W. H. P. Hains, commanding, reported as follows: "December 19th: a heavy gale set in from s. at noon in N. 45°, W. 49°, accompanied by heavy rain and lightning of dazzling brilliancy. A force of 10 was felt about midnight, and occasionally in squalls it rose to 12. The lowest barometer was 28.96 (735.6) at 10 p. m.; it began to rise at

midnight. The wind veered to west and attained its greatest force after the barometer began to rise."

By the 20th the centre of disturbance had reached N. 50°, W. 45°, having moved northeastward at no great distance from the Newfoundland coast; on this date the s. s. "Circassian," W. Richardson, commanding, had a heavy s. gale, hauling to w., with torrents of rain and very high sea, in N. 50° 10', W. 44° 0', and moderate to strong s. gales were reported to the eastward as far as the thirtieth meridian.

On the 22d the depression was shown near N. 52°, W. 25°; the s. s. "Wandrahm," N. J. Hundewadt, commanding, had a heavy gale from wsw. to sw. and nw., in N. 47° 30', W. 27° 10', lowest barometer reading 29.55 (750.6), and other vessels, between W. 25° and 15°, had moderate to strong s. gales, with barometer ranging from 29.46 (748.3) to 29.9 (759.4). A rapid increase had occurred in the barometric gradient to the westward of thirtieth meridian, so that strong nw. gales prevailed over that region.

By the 23d the depression had either filled in or moved with greatly increased pressure toward the northern coast of the British Isles.

6.—This area is a continuation of the disturbance described as low area vii. under "Areas of low barometer." During the 25th, the depression passed northeastward along the coast of Nova Scotia and over Newfoundland, and on the 26th it was to the northward of 50° N., and between W. 40° and 50°. The barometer ranged from 29.7 (744.4) to 29.9 (759.4), with strong breezes to gales from w. and sw. over the region between N. 45° and 50°, and from the eastern coast of Newfoundland to the fortieth meridian. By the 27th, the disturbance had disappeared.

7.—This disturbance occupied mid-ocean during the closing days of the month; on the 29th, there was a decrease of about .3 inch over the region north of the forty-fifth parallel, and from W. 40° eastward to W. 20°; until the close of the month, the pressure over the above region ranged from 29.23 (742.4) to 29.7 (754.4).

TEMPERATURE OF THE AIR.

[Expressed in degrees, Fahrenheit.]

The distribution of mean temperature over the United States and Canada for December, 1884, is exhibited on chart ii. by the dotted isothermal lines; and in the table of miscellaneous data are given the monthly means for the various stations of the Signal Service.

In the following table are given the averages for the several geographical districts with the normals and departures, as deduced from the Signal Service observations:

Average temperatures for December, 1884.

Districts.	Average for Dec., Signal-Service ob- servations.		Comparison of Dec., 1884, with the average for several years.
	For sev- eral years.	For 1884.	
New England.....	30.4	31.9	+ 1.5
Middle Atlantic states.....	36.7	38.1	+ 1.4
South Atlantic states.....	48.5	50.4	+ 1.9
Florida peninsula.....	62.1	64.0	+ 1.9
Eastern Gulf states.....	50.3	51.3	+ 1.0
Western Gulf states.....	50.5	48.9	- 1.6
Rio Grande valley.....	60.4	59.1	- 1.3
Tennessee.....	41.7	41.2	- 0.5
Ohio valley.....	35.4	34.3	- 1.1
Lower lake region.....	28.8	28.7	- 0.1
Upper lake region.....	24.6	22.9	- 1.7
Extreme northwest.....	11.1	5.2	- 5.9
Upper Mississippi valley.....	28.3	24.3	- 3.9
Missouri valley.....	23.7	14.2	- 9.5
Northern slope.....	23.6	8.5	- 15.1
Middle slope.....	30.9	21.5	- 9.4
Southern slope.....	35.3	44.1	+ 8.8
Southern plateau.....	44.3	44.0	- 0.3
Middle plateau.....	31.3	34.4	+ 3.1
Northern plateau.....	32.9	19.5	- 13.4
North Pacific coast region.....	41.2	33.7	- 7.5
Middle Pacific coast region.....	48.3	49.6	+ 1.3
South Pacific coast region.....	55.3	53.1	- 2.2
Mount Washington, N. H.....	8.9	11.9	+ 3.0
Pike's Peak, Colo.....	6.5	5.4	- 1.1

On chart iv. the deviations from the normal temperatures are graphically exhibited by dotted lines connecting stations of equal departures.

In the districts on the Atlantic and Gulf coasts, in the middle plateau and middle Pacific coast region, the mean temperature for December has been above the normal, the stations reporting the greatest departures being as follows: Kitty Hawk, North Carolina, +3°.6; Barnegat City, New Jersey, +3°.5; New Orleans, Louisiana, +3°.4; Wilmington, North Carolina, and Salt Lake City, Utah Territory, +3°.3; Portland, Maine, Augusta, Georgia, and Winnemucca, Nevada, +3°.2.

In Texas and over the interior and northwestern portions of the country the mean temperature for the month has been below the normal, the departures being unusually large from the upper Mississippi valley westward to the Pacific coast; at stations in Montana the mean temperatures varied from 15° to 23°.3 below the normal.

DEVIATIONS FROM MEAN TEMPERATURE.

The departures exhibited by the reports from the regular Signal Service stations are shown in the table of average temperatures for the various districts; in the table of miscellaneous data, and on chart iv. The following notes in connection with this subject are reported by voluntary observers:

Arkansas.—Lead Hill, Boone county: mean temperature, 29°.1 is 11°.4 below the December average for the last three years.

Dakota.—Webster, Day county: mean temperature, 9°.1, is 5°.6 below the December average for the two preceding years.

Illinois.—Mattoon, Coles county: mean temperature, 28°.5, is 2°.1 below the December average for the last four years.

Swanwick, Perry county: mean temperature, 29°.2, is 4°.7 below the December average for the last two years.

Riley, McHenry county: mean temperature, 19°.4, is 2°.4 below the December mean for the last twenty-three years.

Peoria, Peoria county: mean temperature, 27°.3, is 1°.4 below the December average for the last thirty years.

Sycamore, DeKalb county: mean temperature, 20°.5, is 7°.0 below the December average for the last three years.

Indiana.—Vevay, Switzerland county: mean temperature, 34°.0, is 0°.7 below the December average for the last twenty-one years.

Wabash, Wabash county: mean temperature, 26°.0, is 3°.9 below the December average of the last eight years.

Spiceland, Henry county: mean temperature, 27°.2, is 2°.0 below the December average for the last thirty-one years.

Iowa.—Dr. Gustavus Hinrichs, director of the State Weather Service, Iowa City, reports the mean temperature for the month to have been 5° below the normal.

Kansas.—Independence, Montgomery county: mean temperature, 25°.4, is 6° below the December average for the last thirteen years.

Emporia, Lyon county: mean temperature, 22°.4, is 7°.4 below the normal; it was 9°.5 below the December average for the four preceding years.

Lawrence, Douglas county: mean temperature, 23°.5, is 6°.3 below the December average for the last sixteen years.

Wellington, Sumner county: mean temperature, 23°.1, is 6°.9 below the December average for the last six years.

Maine.—Gardiner, Kennebec county: mean temperature, 26°.8, is 4°.4 above the December average for the last forty-nine years.

Maryland.—Fallston, Harford county: mean temperature, 34°.0, is 0°.9 above the December average for the last nine years.

Missouri.—Saint Louis: mean temperature, 29°.8, is 3°.6 below the December normal.

New Hampshire.—Contoocook, Merrimack county: mean temperature, 27°.9, is nearly 4°.5 above the December average.

New Jersey.—South Orange, Essex county: mean temperature, 33°.9, is 3°.7 above the December average for the last fifteen years.